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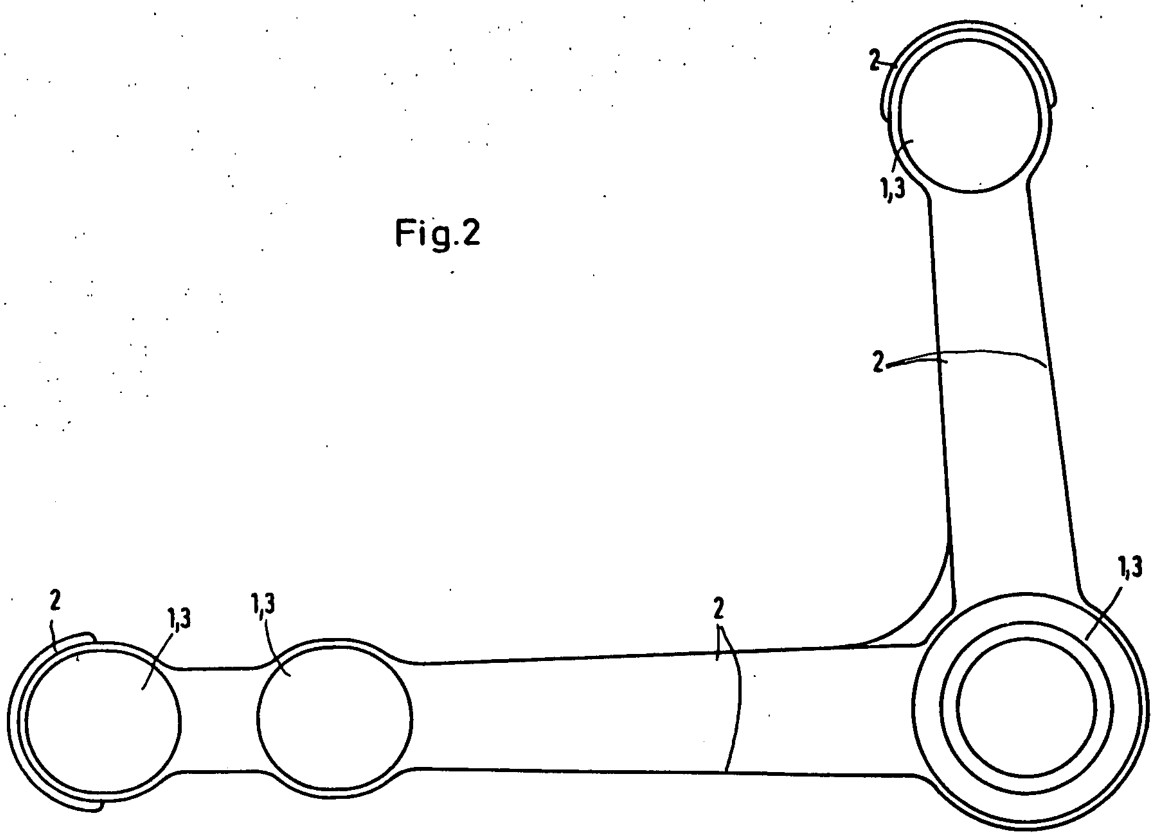
(54) **Vehicle components for high bending fatigue loads**

(57) Vehicle components are formed, especially steering components required to sustain high bending fatigue loads, by forging a material of the nominal composition C 0.35—0.45, Si <0.5, Mn 0.6—0.9, Cr 0.7—1.1, Mo 0.25—0.45, Ni 1.6—2.1, remainder iron and normal impurities, and after forging they are machined (at 1) and also locally heat treated and/or surface hardened (at 3). The vehicle components retain their favourable properties even at low temperatures in the temperature range down to −50°C. Forging flash may form reinforcement ribs (2) to increase the resistance moment and ensure that the component will fail safe under overload.

Fig.2



The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.
The references to Figure 1 of the drawings in the printed specification are to be treated as omitted under Section 15(2)/(3) of the Patents Act 1977.

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SPECIFICATION

Vehicle components for high bending fatigue loads

This invention relates to the manufacture of vehicle components, more particularly steering components, adapted to sustain high bending fatigue loads. The term "high bending fatigue loads" refers to the number of load reversals, their frequency and their amplitude. Numerous vehicle components are subjected to high bending fatigue loads in this sense, but steering components are particularly high loaded.

Known components for this specific purpose are usually made from a steel having a carbon content of 0.2—0.45%, often alloyed with small amounts of chromium and/or magnanese (typical constructional steels include Ck 45 and Ck 35, in many cases 16 Mn Cr 5 and 41 Cr 4, and for many larger components 42 Cr Mo 4). The components are dimensioned in conformity with the loads to be sustained, on the basis of the laws of engineering. In these circumstances, the components must be made relatively heavy to sustain the loads. Although weight reductions can often be achieved by adopting sheet constructions, space problems often arise in the steering system. The optimisation of steering performance requires the minimisation of unsprung masses. For this reason, together with the requirements of fuel economomy, it is essential to minimise the weight of these vehicle components. Moreover, it is clear that the known vehicle components can fail under sudden overloading following significant prior fatigue loading. The inspection costs of identifying components liable to fail in this manner amount to 5% of the total component costs and in some cases even higher. Consequently, one aspect of progress towards greater economy is to ensure that components will fail safe under overload, that they do not need repeated check tests to minimise the risks to the vehicle occupants and that they can be quality controlled by a spot-check procedure based on the state of the art. Otherwise, the risk of faulty components which will fail suddenly in a brittle manner, with dire consequences, requires this costly 100% inspection (specific danger points include surface laps, various compression zones as formed for example by surface rolling, and the typical defects found in components made by chipless forming).

In this context, the object of the invention is to provide vehicle components for the purpose specified, which can sustain high bending fatigue loads, have an outstandingly high long-term fatigue strength and will moreover fail safe under overload, particularly under sudden overloading following significant prior fatigue loading.

According to the present invention, a method of manufacturing vehicle components required to sustain high bending fatigue loads comprises forming the vehicle components by forging a material of the type having the nominal composition

C	0.35—0.45
Si	<0.5
Mn	0.6—0.9
Cr	0.7—1.1
Mo	0.25—0.45
Ni	1.6—2.1,

remainder iron and normal impurities, the vehicle components after forging being at least partially machined and at least locally heat treated and/or surface hardened. Thus the invention relates in general to the use of a material devoid of the normally appreciable strain capacity for the loading conditions under consideration, or in other words undergoing no significant cold work hardening under load preceding strain and within the strain range. This requirement also includes behaviour under multi-axial stressing conditions.

The material is preferably suitable for use of the vehicle components not only in the normal temperature range but also in a temperature range down to −50°C. The material is particularly suitable for use in the manufacture of vehicle components comprising steering components. Nevertheless, it is also suitable for use in the manufacture of vehicle components comprising parts of a system for the damping of body vibrations. The vehicle components may be provided with differing strengths in different regions, whereby it is often possible to achieve a substantial improvement in what is known as the form-strength of the components.

The accruing advantages are to be seen in that the vehicle components manufactured by the method of the invention are outstandingly superior in respect of a very high fatigue strength and a fail safe behaviour under sudden overload, particularly following significant prior fatigue loading. The material used has a high toughness, which largely exclude brittle failure. Surprisingly, the material can be surface hardened without thereby losing its extraordinarily tough matrix structure. Surface hardening to a shallow depth can be effected inductively for example. Moreover, after machining it can be treated to a condition combining high strengths and yield points, together with values for elongation and reduction of area superior to the usual levels for vehicle components. It is a further surprising fact that these favourable conditions are not substantially impaired in the quoted low-temperature range. Widely variable strengths can be provided within the components and thereby optimising the components with respect to stiffer and more resilient zones or components. In particular, the possibility is afforded of displacing load peaks into zones particularly adapted to sustain these load peaks by heat treatment and/or surface hardening.

Two embodiments of vehicle components of the invention will now be described, by way of

example, only, with reference to the accompanying drawings, in which:—

Figure 1 is a side elevation of a swivel bearing for a vehicle having a front wheel drive; and

Figure 2 is a side elevation of a track lever for an omnibus.

The vehicle components shown in the drawings were made from a material of the alloy type having the nominal composition

C	0.35—0.45
Si	<0.5
Mn	0.6—0.9
Cr	0.7—1.1
Mo	0.25—0.45
Ni	1.6—2.1,

remainder iron and normal impurities.

The swivel bearing of Figure 1 was formed by closed-die forging and surfaces 1 were machined after forging. It was also heat treated to attain a higher strength in zones 2 and surface hardened over zones 3.

The track lever of Figure 2 was also forged, but machined at 1, and surface harded at 3 but the otherwise completely removed flashes were left in place in zones 2 to increase the resistance moment. The reinforcement ribs formed by the forging flash were optimised so that any incidental tears would result in cracking starting at the outside and then running along the rib, thereby shielding the main cross-section of the component. In this way, inspection is facilitated prior to final rejection of the component.

CLAIMS

1. A method of manufacturing vehicle components required to sustain high bending fatigue loads comprising forming the vehicle components by forging a material of the type having the nominal composition

C	0.35—0.45
Si	<0.5
Mn	0.6—0.9
Cr	0.7—1.1
Mo	0.25—0.45
Ni	1.6—2.1,

remainder iron and normal impurities, the vehicle components after forging being at least partially machined and at least locally heat treated and/or surface hardened.

2. A method as in Claim 1, wherein the material is suitable for use of the vehicle components in a temperature range down to −50°C.

3. Vehicle components formed by the method of Claim 1 or Claim 2.

4. Vehicle components as in Claim 3 and comprising steering components.

5. Vehicle components as in Claim 3 and comprising parts of a system for the damping of body vibrations.

6. Vehicle components as in any one of Claims 3 to 5, wherein the vehicle components have differing strengths in different regions.

7. Vehicle components as in any one of Claims 3 to 6, wherein forging flash forms a reinforcement rib to increase the resistance moment and simultaneously ensures that the component will fail safe under overload.

8. Vehicle components substantially as hereinbefore described with reference to the accompanying drawings.

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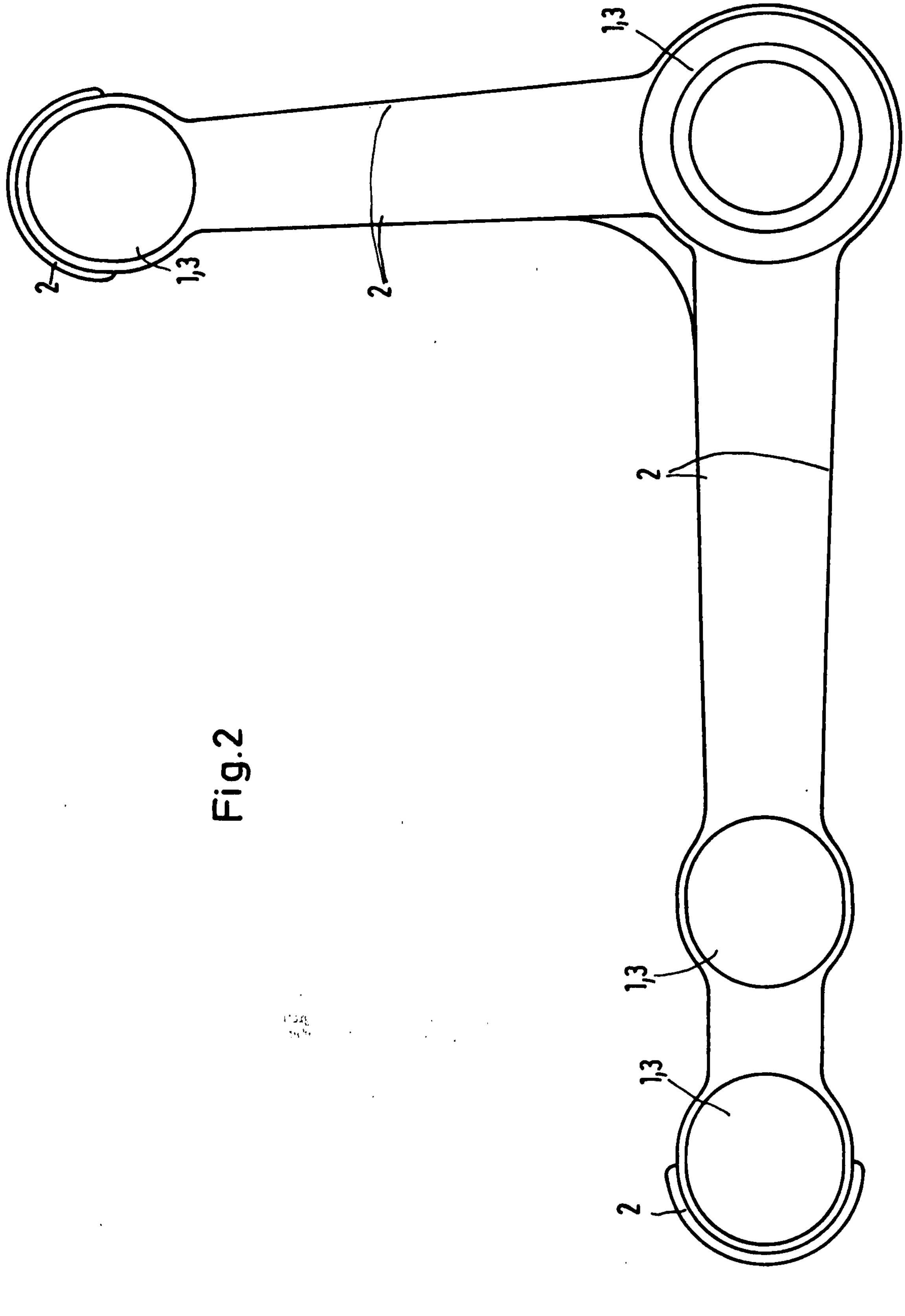

Fig.2